Optimizing Aperture Photometry for PreCam: FWHM Cuts

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(FNAL)

DES Calibrations Telecon

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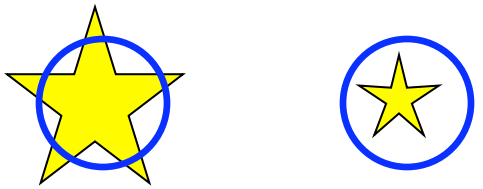
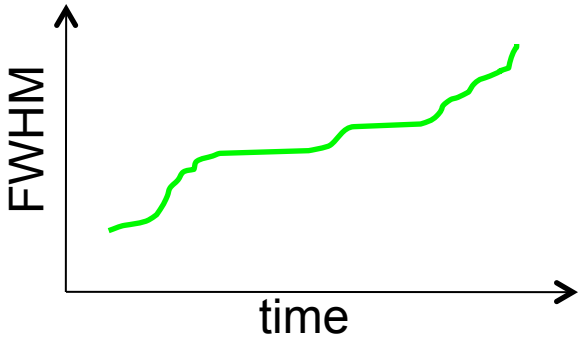
Why FWHM Cuts?

DARK ENERGY SURVEY

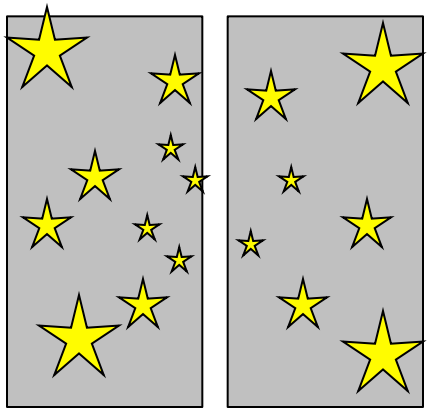
1. The fraction of light measured in a fixed aperture depends on the PSF size of the star.



2. For calibrations during the night, variations in seeing/focus can add difficulties in comparing photometry for exposures taken at different times during the night.

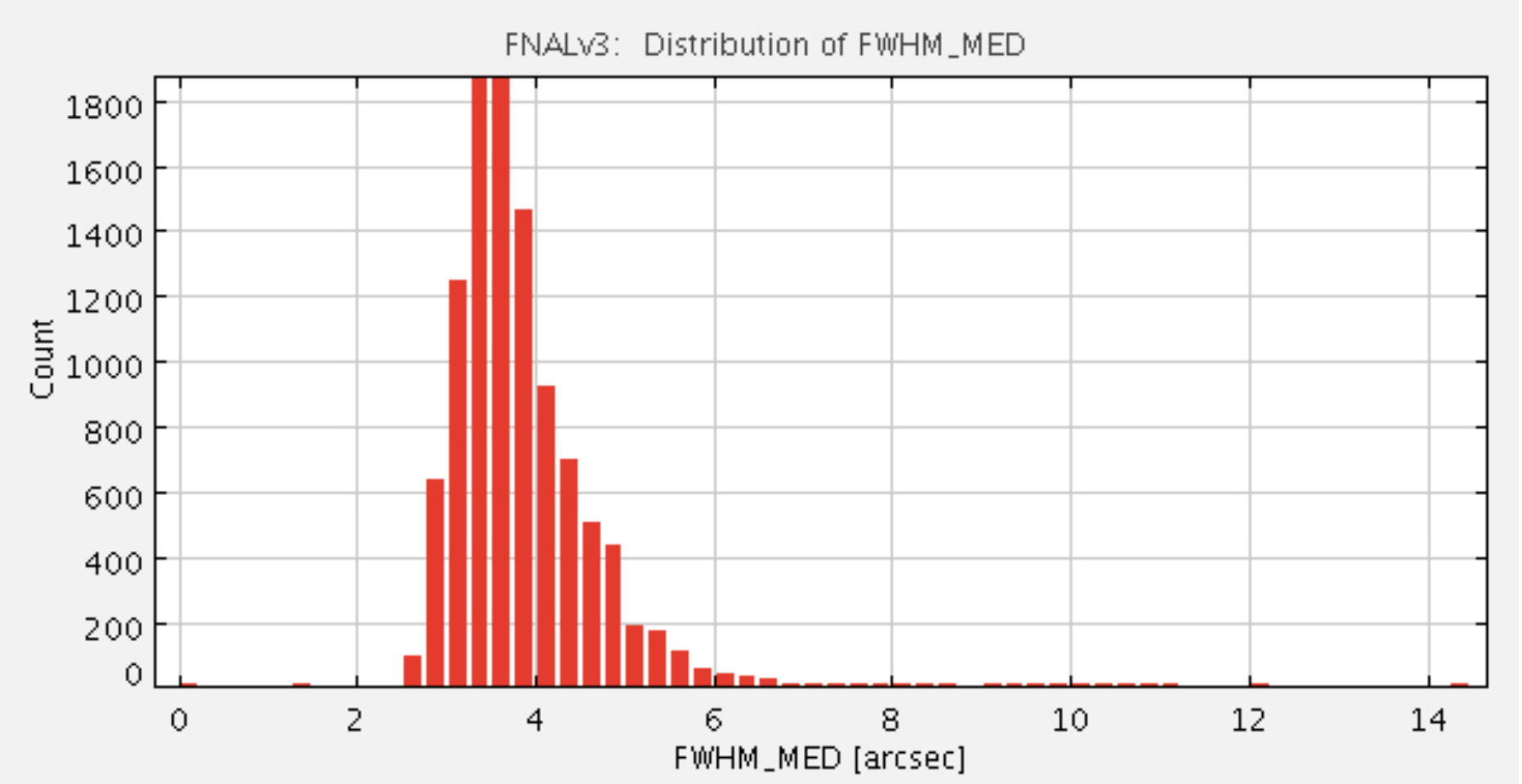


3. For PreCam, the PSF varies substantially across the focal plane, adding difficulties in comparing photometry of objects at different locations within the same image… *or of the same objects in overlapping exposures.*



Where to Cut?: Distribution of FWHM_MED? Problems

DARK ENERGY SURVEY

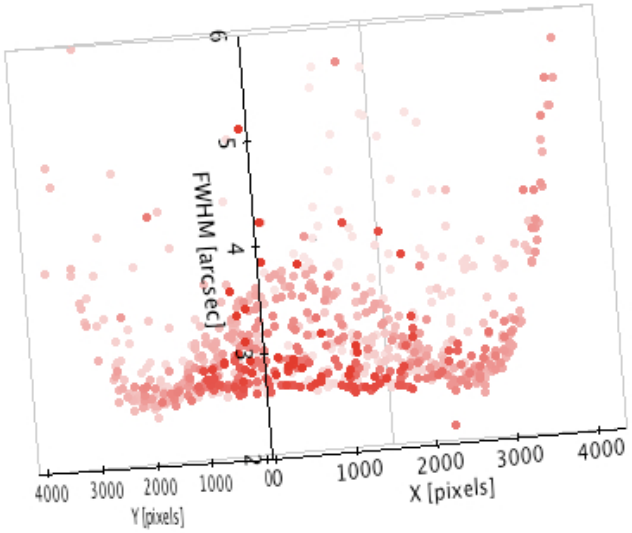


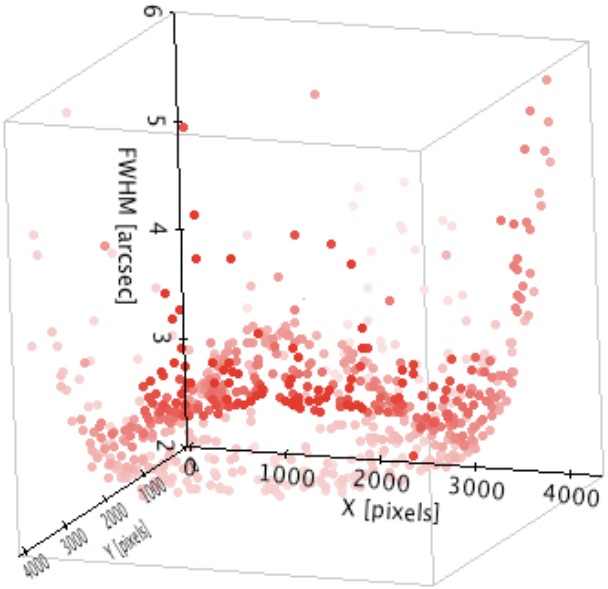
(Histogram includes all FNALv3 ccmap-wcs-*.v3.cat files.)

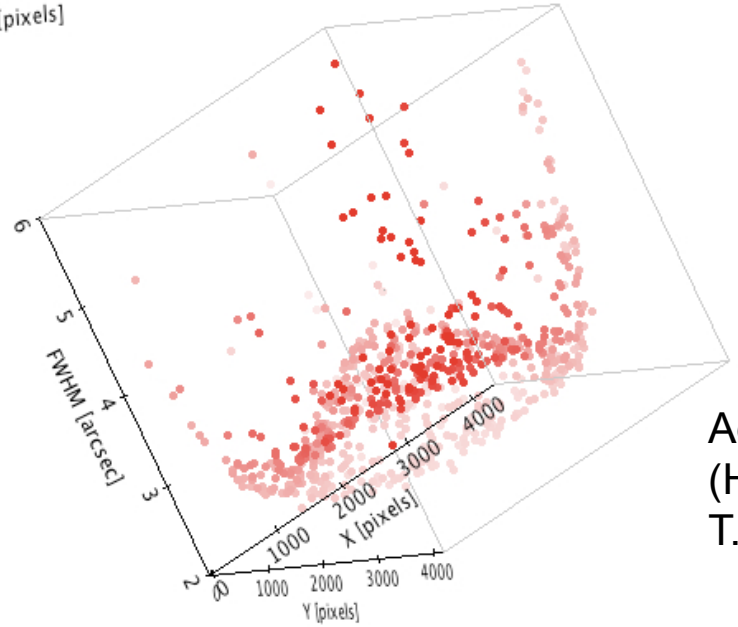
3D Distribution of FWHM vs. X,Y: The Mexican Hat

DARK ENERGY SURVEY

A Good Image
At Different Orientations







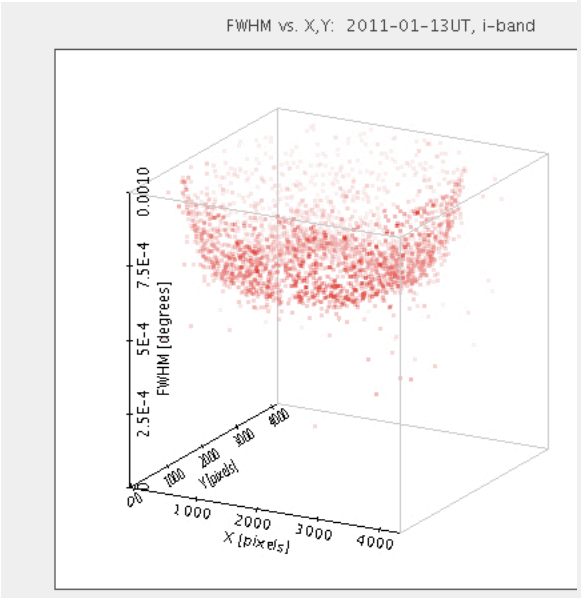
Additional confirmation of ANL results (H. Spinka, S. Kuhlmann, K. Kuehn, & T. Bailey)

3D Distribution of FWHM vs. X,Y for Images with Good, OK, and Poor Focus

DARK ENERGY SURVEY

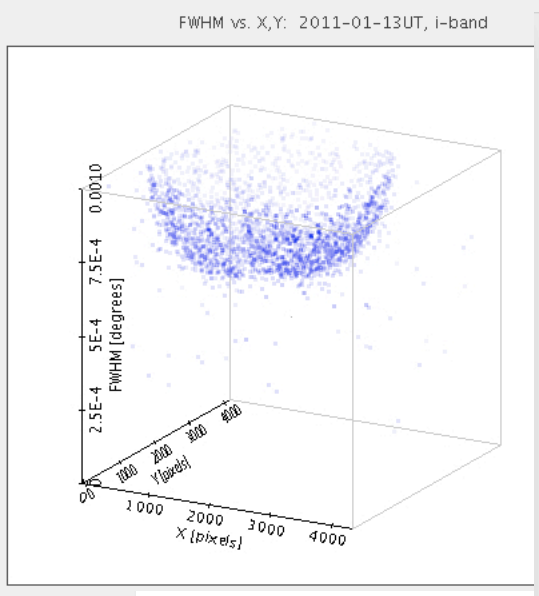
Individually

Good



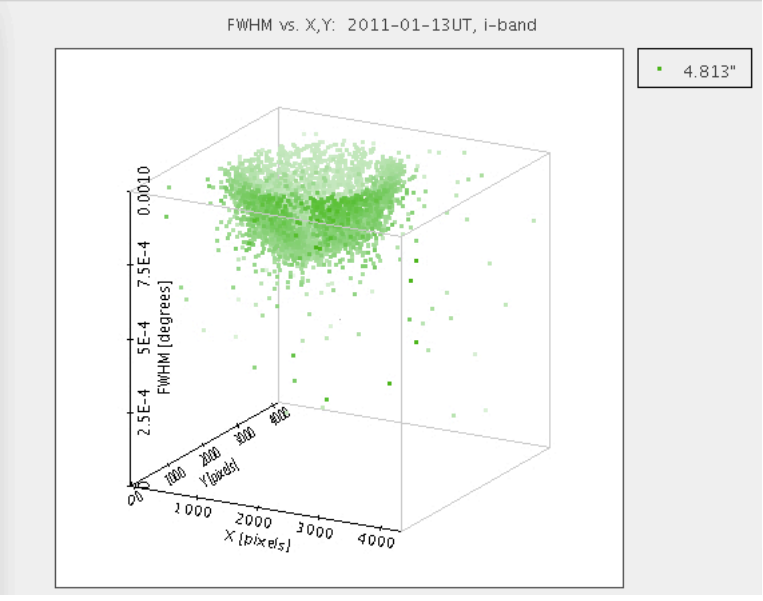
Mexican Hat

OK



Mexican Hat with Lower Central Peak

Bad



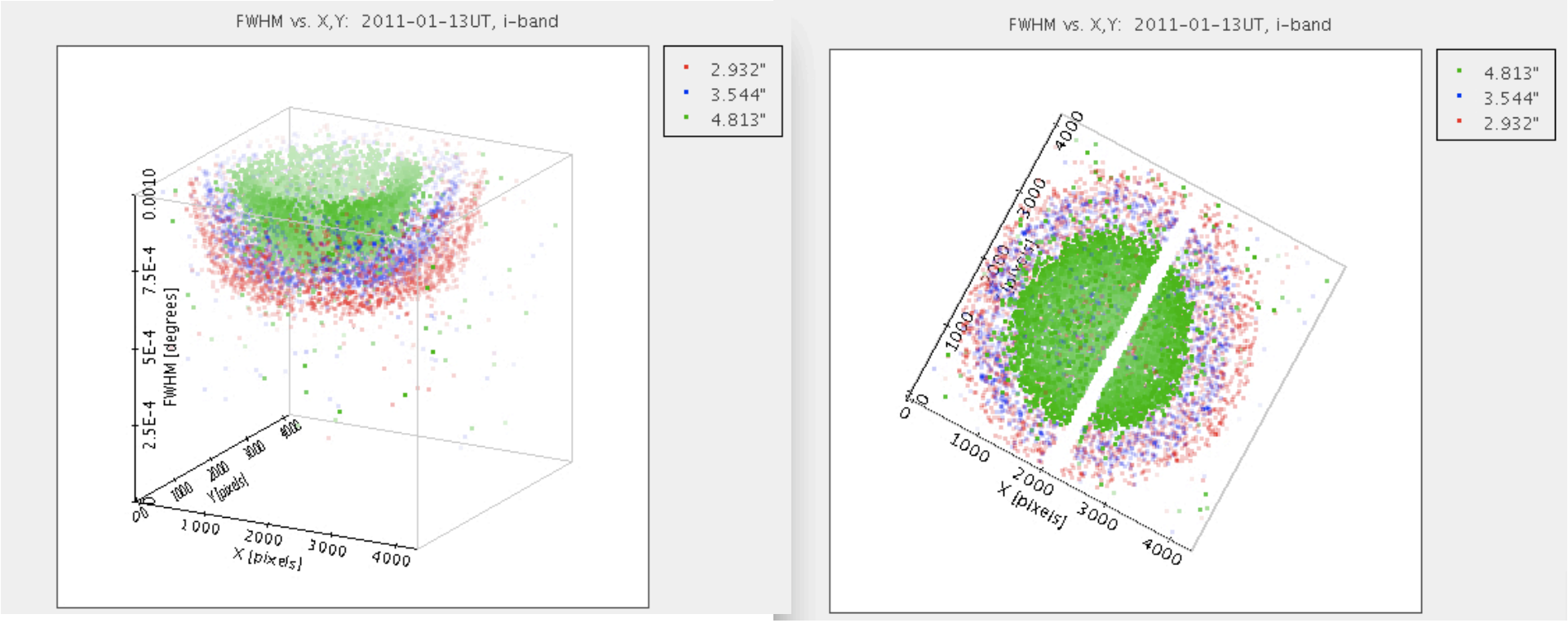
Paraboloid-ish

(Object images with FWHM>3.6 arcsec have been cut.)

3D Distribution of FWHM vs. X,Y for Images with Good, OK, and Poor Focus

DARK ENERGY SURVEY

All Together,
At Different Orientations



(Object images with FWHM>3.6 arcsec have been cut.)

Percentage of Flux for a Gaussian Point Source within a Circular Aperture

DARK ENERGY SURVEY

PSF		PERCENTAGE OF FLUX WITHIN APERTURE DIAMETER							
FWHM (")	FWHMpix (pix)	24.00" 16.55pix	14.86" 10.25pix	12.00" 8.28pix	10.00" 6.90pix	8.00" 5.52pix	6.00" 4.14pix	4.00" 2.76pix	2.00" 1.38pix
2.0	1.4	100.0000	100.0000	100.0000	100.0000	99.9985	99.8038	93.7379	49.9759
2.5	1.7	100.0000	100.0000	100.0000	99.9985	99.9169	98.1496	83.0215	35.8089
3.0	2.1	100.0000	100.0000	99.9985	99.9545	99.2742	93.7379	70.8118	26.4975
3.5	2.4	100.0000	99.9996	99.9709	99.6498	97.3186	86.9396	59.5339	20.2423
4.0	2.8	100.0000	99.9929	99.8038	98.6821	93.7379	78.9548	49.9759	15.9002
4.5	3.1	100.0000	99.9476	99.2742	96.7306	88.7990	70.8118	42.1485	12.7875
5.0	3.4	100.0000	99.7797	98.1496	93.7379	83.0215	63.1177	35.8089	10.4906
5.5	3.8	99.9998	99.3631	96.3018	89.8713	76.9031	56.1471	30.6753	8.7523
6.0	4.1	99.9985	98.5718	93.7379	85.3988	70.8118	49.9759	26.4975	7.4076
6.5	4.5	99.9921	97.3223	90.5655	80.5912	64.9798	44.5783	23.0728	6.3474
7.0	4.8	99.9709	95.5909	86.9396	75.6735	59.5339	39.8842	20.2423	5.4975
7.5	5.2	99.9169	93.4071	83.0215	70.8118	54.5292	35.8089	17.8830	4.8063
8.0	5.5	99.8038	90.8362	78.9548	66.1181	49.9759	32.2689	15.9002	4.2368
8.5	5.9	99.6003	87.9609	74.8556	61.6611	45.8586	29.1875	14.2207	3.7622
9.0	6.2	99.2742	84.8674	70.8118	57.4777	42.1485	26.4975	12.7875	3.3627
9.5	6.6	98.7975	81.6361	66.8853	53.5826	38.8107	24.1414	11.5559	3.0233
10.0	6.9	98.1496	78.3365	63.1177	49.9759	35.8089	22.0700	10.4906	2.7326
10.5	7.2	97.3186	75.0261	59.5339	46.6485	33.1080	20.2423	9.5636	2.4818
11.0	7.6	96.3018	71.7502	56.1471	43.5859	30.6753	18.6234	8.7523	2.2638
11.5	7.9	95.1044	68.5431	52.9616	40.7707	28.4807	17.1842	8.0385	2.0732
12.0	8.3	93.7379	65.4299	49.9759	38.1846	26.4975	15.9002	7.4076	1.9057

Percentage of Flux for a Gaussian Point Source within a Circular Aperture

DARK ENERGY SURVEY

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8.5	5.9				61.6611	45.8586	29.1875	14.2207	3.7622
9.0	6.2				57.4777	42.1485	26.4975	12.7875	3.3627
9.5	6.6				53.5826	38.8107	24.1414	11.5559	3.0233
10.0	6.9				49.9759	35.8089	22.0700	10.4906	2.7326
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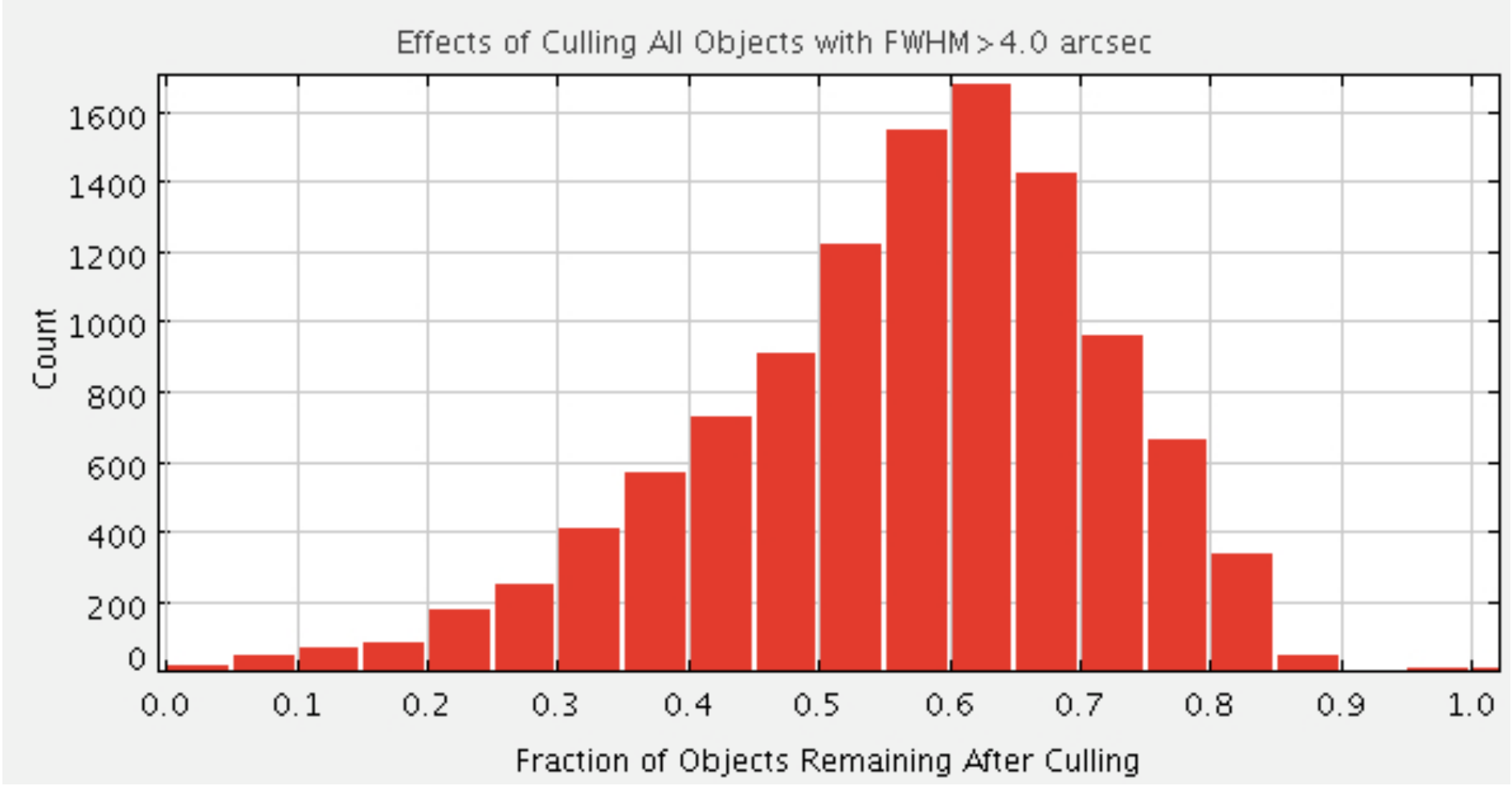
12.0	8.3	93.7379	65.4299	49.9759	38.1846	26.4975	15.9002	7.4076	1.9057

Larger apertures: more sky background and noisier results

Effects of Culling All Objects @ FWHM>4": Fraction of Objects Remaining

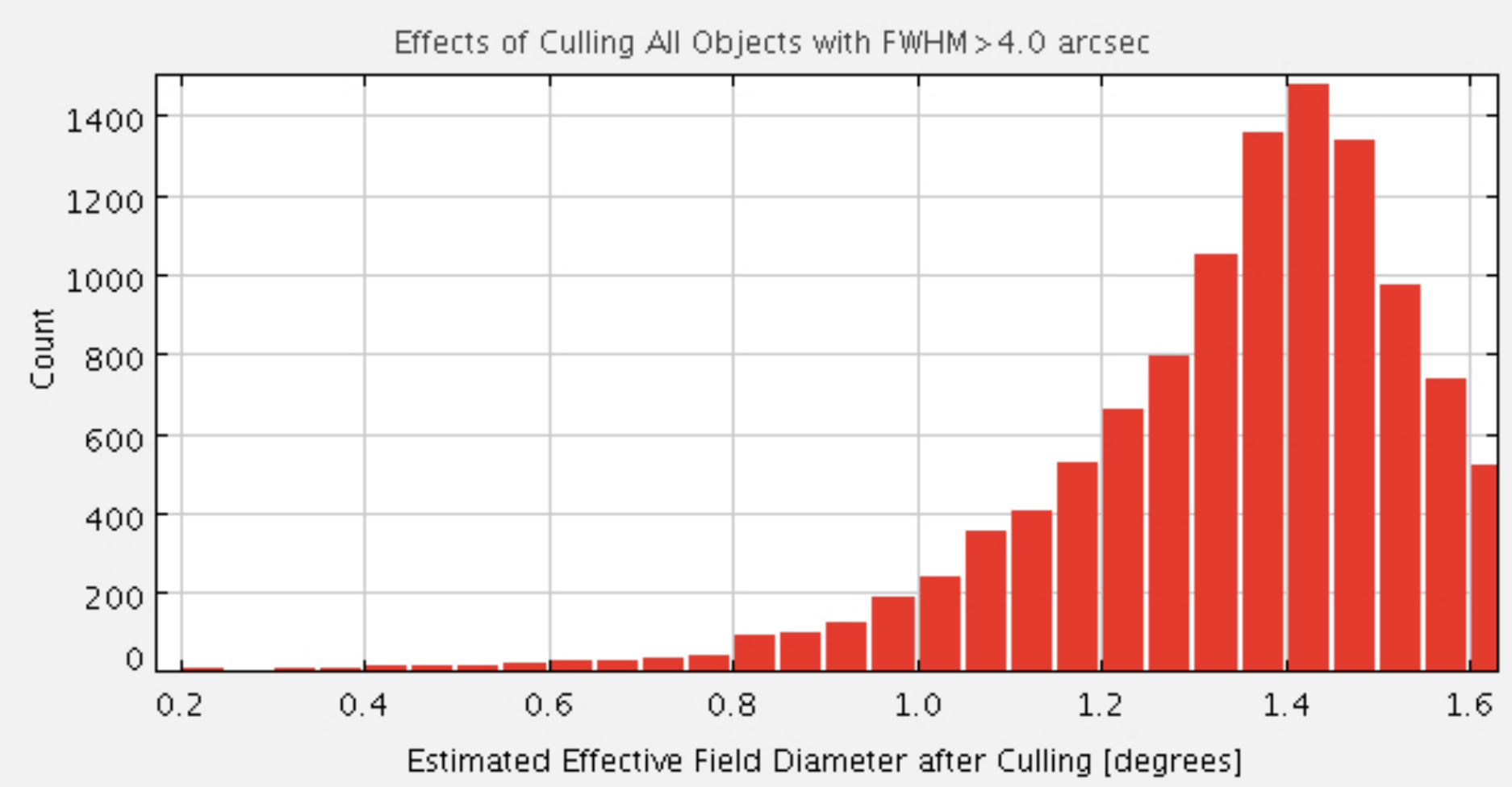
DARK ENERGY SURVEY



(Histogram includes all FNALv3 ccmap-wcs-*.v3.cat files.)

Effects of Culling All Objects @ FWHM>4": Estimated Effective Field Diameter

DARK ENERGY SURVEY



(Histogram includes all FNALv3 ccmap-wcs-*.v3.cat files.)

DARK ENERGY
SURVEY

Conclusion

- Culling objects with FWHM > 4.0 arcsec and using an aperture of diameter 10.0 arcsec (6.90 pixels) seems a reasonable choice (but maybe not the only choice).

- For the ccmap-wcs-*.v3.cat files, mag_aper_10 corresponds to an aperture diameter of 10.0 arcsec (6.90 pixels).

DARK ENERGY
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Extra Slides